REMARKS

Reconsideration and allowance in view of the foregoing amendments and the following remarks are respectfully requested.

Claims 1-19 are pending.

Please return a copy of the form PTO 1449, filed August 31, 1995, per MPEP 609, with the Examiner's initials in the left column.

Claims 6-17 were rejected under 35 U.S.C. 112, second paragraph as being indefinite. The claims have been revised so as to obviate this rejection.

In respect to the Examiner's objection to the term "high emissivity" in Claims 12 and 16, reconsideration is respectfully requested. Indeed, each of these claims specifies that the external electrode consists of a material having an emissivity lower than the emissivity of the internal electrode. Thus, "high emissivity" is not vague because it is clear from the text of the claim that the emissivity is higher than the emissivity of the material of the external electrode. If the Examiner remains of the view that the term "high" must be deleted for the claim to be definite, then the favor of a telephone interview, proposing to delete this term by Examiner's amendment, is requested.

In the Official Action, claims 1-4 were rejected under 35 U.S.C. 102(b) as anticipated by Csanitz et al. Applicant respectfully traverses this rejection.

In Csanitz, a movable granule 39 is loosely retained and located in at least part of the hollow chamber. The granule 39 has a surface hardness which is as great as that of the reference electrode 22. The granule is formed to protect the reference electrode from stain which may deteriorate the activation. The granule is filled between the heater and the reference electrode so as to contact it. In Csanitz, the entire heat capacity is large because of the filled agent, and the temperature is not increased promptly. Therefore, sufficient reference gas cannot be supplied to the internal electrode.

In contrast, in the present invention, a clearance of 0.1 mm or more is formed between the high-emissivity layer and the internal electrode so that sufficient reference can be introduced. That is, the heat of electromagnetic wave, emitted from the heater, is directly absorbed by the solid electrolyte in the clearance (nothing is filled in the clearance). Therefore, the heat is effectively and promptly transferred to the internal electrode.

Therefore, the claims are not anticipated by nor obvious from Csanitz.

Claim 5 was rejected under 35 U.S.C. 103 as being unpatentable over Csanitz et al alone or in view of Agarwal. The Applicant respectfully traverses this rejection.

The polygonal heater is disposed outside the sensor. In the present invention, the surface of the heater facing the inside surface of the cup-shaped solid electrolyte is polygonal. In this way, it is possible to use the surface area of the heater effectively. That is, when the cross sectional area is identical, the polygonal shape makes the surface area larger.

The larger the cross sectional area of the heater, the higher the heat transfer to the base end side. Therefore, even if the cross sectional area is simply increased, although the heat radiating amount is increased, the heat transfer to the base end side is also increased, thereby making it impossible to improve the radiating performance simply. Accordingly, while the cross sectional area is kept constant, the surface area needs to be enlarged.

In the present invention, the surface shape of the heater facing to the inner surface of the solid electrolyte is polygonal, and thereby the surface area is enlarged without extremely enlarging the cross sectional area. Thus, such a structure is not merely a design choice.

Claims 1-8 were rejected under 35 U.S.C., 103 as being unpatentable over Togawa in view of Sakurai. Claims 1-5 and 9-11 were also rejected under 35 U.S.C. and 103 as being unpatentable over Sakurai in view of Agarwal.

In Togawa, the external electrode, which is formed on the solid electrolyte, is made of SiC.

In Togawa and Sakurai, there is no disclosure of the porosity of the high-emissivity layer being a predetermined value to keep a diffusion of the air into the internal electrode. Further, the electrode itself is made of silicon carbide. However, in the present invention, the electrode is made of a material mostly including a metal having a high conductivity and a high heat resistance, which is completely different from Togawa. In the present invention, silicon carbide is employed for the heater, not for the electrode. In this way, the heat radiation is improved, temperature of the solid electrolyte can be increased effectively, and further, the electrode having a high conductivity and a high heat resistance can be applied.

In Agarwal, ZrO_2 13 sensor having a closed end, is surrounded by the heating elements 11 and 12. However, according to the present invention, the heater is inserted into an inside of the cup-shaped electrolyte and made of non-oxide type ceramic (for example, Si_3N_4, AlN, SiC). When the heater is inserted into the solid electrolyte, the heat is accumulated therein. In the

conventional heater, the heater should generate heat at a temperature lower than that outside the electrolyte. Therefore, in order to raise the temperature of the solid electrolyte sufficiently with the low temperature heat, the heater having a good heat efficiency is needed. Accordingly, in the present invention, the heater made of non-oxide type ceramic is employed for the cup-shaped electrolyte.

In this way, with a high emitting electric heat efficiency, it is easy to raise the temperature of the solid electrolyte without raising the temperature of the heater itself, and, therefore, long heater life can be obtained.

Claims 1-8 and 12-15 were rejected by Sakurai in view of Hackh's.

Certainly, it is expected by the person having an ordinary skill in the art, that the external electrode, which is exposed to the exhaust gas, is made of the active electrode to ionize the oxygen in the exhaust gas.

However, the present invention is directed to the internal electrode, and such internal electrode does not need to be made of the strong active material, because such internal electrode is exposed to the reference gas (air). Accordingly, it is not anticipated by nor obvious from the prior art for the internal electrode to be made of the platinum black, which is strong

active material, because the internal electrode does not need to be such strong active material.

Claim 5 was rejected by Sakurai in view of Hackh's and Agarwal. As described above, Claim 5 is not anticipated by these references. There is no reason or suggestion for such combinations, and further, even if these references are combined, the structure of the present invention does not result.

Claims 16 and 17 were rejected over Sakurai, Hackh's and Topp. In this rejection, there is no reason or suggestion for such combinations. In Topp, the electrode consisting of the catalyst layer made of platinum, aluminum, cobalt, nickel, chromium alloy or the like is formed on solid electrolyte of Kaolin and Feldspar by painting the paste and sintering; however, Kaolin has a high emissivity.

Claims 1-8 and 12-17 were rejected over Matsumoto in view of Sakurai. There is no disclosure of a clearance formed between the high-emissivity layer and the internal electrode. In Matsumoto, such a clearance is not required.

Claim 5 was rejected over Matsumoto in view of Sakurai and Agarwal. Again, there is no disclosure of a clearance formed between the high-emissivity layer and the internal electrode.

Claims 1-5 were rejected over Bode in view of Sakurai. In Bode, the sensor is not a type which introduces oxygen; namely,

the coating layer 13 is formed to prevent air from flowing therethrough. This oxygen sensor does not need a reference gas.

Therefore, even when the heater is inserted, the oxygen introduction is not considered; thus, there is no suggestion of the clearance of the invention.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance and a Notice to that effect is solicited.

Respectfully submitted,

CUSHMAN DARBY & CUSHMAN, L.L.P.

By _____
Michelle N. Lester
Reg. No. 32,331
Tel: (202) 861-3693
Fax: (202) 822-0944

MNL:cjt

1100 New York Avenue, N.W.
Ninth Floor, East Tower
Washington, DC 20005-3918
(202) 861-3000